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Lens and Optical System Design and Engineering R. B. Johnson, W. H. Swantner, Chairs

Title: New Spectrometer Designs for AVIRIS

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Abstract:

For over a decade, the Airborne Visible and Infrared Imaging Spectrometer (AVIRIS) has been providing high quality hyperspectral data to the remote sensing community. The performance of AVIRIS has been improving steadily, and this has led to the desire to improve the calibration stability and also to reduce the size of the overall system. AVIRIS employs four spectrometers to cover the 380-2500nm range with a 10 nm sampling interval. These spectrometers are very fast (N.A. = 0.45), and have large (200 μm) pixels, requiring considerable dispersion. The existing spectrometers utilize a decentered aperture Schmidt design, in which the grating is formed on the corrector surface, which is a 10^{th} order asphere. A field flattening refractive element is also required. The new designs are of the concentric Dyson form, in which the grating is formed on a concave surface. This design form employs only two spherical surfaces, and yet achieves better or equivalent optical correction, in an optical package that is ~$1/15^{th}$ of the volume of the original. This design is enabled by advanced curved grating fabrication. The gratings are variable ion-etched holographic, although alternative possibilities are under consideration. At this point, the optical designs of all four spectrometers are complete, as is the optomechanical design for spectrometer B. Analysis of the latter has demonstrated that 1% spectral calibration stability should be achievable over a 25°C temperature range with an aluminum structure and a partially sealed package that maintains atmospheric pressure between the two curved surfaces.

Key words: imaging spectrometers, optical design, hyperspectral remote sensing

Author Biography: Pantazis Mouroulis is Principal Optical Engineer at the Jet Propulsion Laboratory, California Institute of Technology, where he is involved in the design of imaging spectroscopy systems and in situ instrumentation. He is the author/editor of two books on optical design, and several papers in various areas of optics.